Claims

1. A method for improving the thermal stability of a distillate fuel which comprises selectively reducing the active concentration in the fuel of N-H containing heterocyclic aromatic compounds in which the nitrogen atom of the N-H group is part of the aromatic system, and wherein said fuel also contains an active concentration of metal compounds or will be exposed to active metal compounds in storage or in use.

2. The method according to claim 1 wherein said fuel contains an active concentration of metal compounds, and which method further comprises reducing the active concentration of metal compounds present in the fuel.

3. The method according to claim 1 or claim 2 which comprises selectively reducing the active concentration of deleterious N-H containing heterocyclic aromatic compounds by treatment with a suitable adsorbent material.

4. The method according to claim 3, wherein the suitable adsorbent material comprises a compound having a benzaldehyde functionality supported on a suitable support.

5. The method according to claim 4, wherein the compound having a benzaldehyde functionality is a 4-aminobenzaldehyde.

6. The method according to claim 5, wherein the 4-aminobenzaldehyde is a 4-dialkylaminobenzaldehyde.

7. The method according to claim 6, wherein the alkyl groups of the 4-dialkylaminobenzaldehyde are independently selected from methyl, ethyl, propyl and butyl.

8. The method according to claim 7, wherein the 4-dialkylaminobenzaldehyde is 4-

dimethylaminobenzaldehyde.

9. The method according to any one of claims 4 to 8, wherein the suitable support is selected from the group consisting of clays, carbons, aluminas, silicas and zeolites.

10. The method according to claim 9 wherein the suitable support is a clay.

11. The method according to claim 10, wherein the clay is a kaolinite.

12. The method according to any one of claims 4 to 11 wherein the compound having a benzaldehyde functionality is adsorbed on the suitable support to a level of at least 0.5 of a monolayer.

13. The method according to claim 12 wherein the compound having a benzaldehyde functionality is adsorbed to a level of from 0.8 to 1.2 monolayers.

14. The method according to claim 12 or claim 13 wherein the compound having a benzaldehyde functionality is 4-dimethylaminobenzaldehyde and the suitable support is kaolinite.

15. The method according to any one of the preceding claims wherein the distillate fuel is selected from the group consisting of jet fuel, avgas, diesel and gasoline.

16. The method according to claim 15, wherein the distillate fuel is a jet fuel.

17. The method according to any one of the preceding claims wherein the N-H containing heterocyclic aromatic compounds comprise one or more of pyrrole, indole, pyrazole, carbazole, substituted pyrroles, indoles, pyrazoles and carbazoles.

18. The method according to claim 17 wherein the N-H containing heterocyclic aromatic compounds comprise one or more of pyrrole, indole, substituted pyrroles and substituted indoles.

19. The method according to any one of the preceding claims wherein the metal compounds comprise compounds of transition metals.

20. The method according to claim 19, wherein the metal compounds comprise copper and/or iron compounds present in the fuel.

21. A test method for determining the thermal stability of a distillate fuel, which test method comprises:

(a) contacting the distillate fuel with a solvent being at least partially immiscible with said fuel and comprising 4-aminobenzaldehyde in formic acid, to form an oil-immiscible layer, and

(b) relating the visible colour and/or colorimetric absorbance between 400 and

700 nm of said oil-immiscible layer to the thermal stability of the fuel.

22. The test method according to claim 21, wherein the 4-aminobenzaldehyde is a 4-dialkylaminobenzaldehyde.

23. The test method according to claim 22, wherein the alkyl groups of the 4-dialkylaminobenzaldehyde are independently selected from methyl, ethyl, propyl and butyl.

24. The method according to claim 23, wherein the 4-dialkylaminobenzaldehyde is 4-dimethylaminobenzaldehyde.

25. The test method according to any one of claims 21 to 24 wherein the colour and/or colorimetric absorbance is measured using a suitable spectrometer to give measured absorption values at one or more values or over one or more ranges within the range 400 to 700 nm.

26. The test method according to claim 25 wherein the measured absorption values are related to thermal stability of the fuel by comparison with suitable reference data comprising absorbance values for suitable reference fuels.

27. The test method according to claim 26 wherein the reference fuels are solutions comprising known concentrations of indole or 2-methylindole in dodecane.

28. The test method according to any one of claims 21 to 27 wherein the distillate fuel is selected from the group consisting of jet fuel, avgas, diesel and gasoline distillate fuels.

29. The test method according to any one of claims 21 to 28 wherein the concentration of 4-aminobenzaldehyde in the solvent is in the range 500 to 5000 mg/l.

30. The test method according to claim 29, wherein the concentration of 4-aminobenzaldehyde in the solvent is in the range 2000 to 3000 mg/l.

31. The test method according to any one of claims 21 to 30, wherein the distillate fuel may be contacted with the solvent by mixing under agitation at ambient temperature.

32. An apparatus suitable for use in the test method according to claims 21 to 31, which apparatus comprises a first vessel containing a determined amount of solvent comprising a determined amount of 4-aminobenzaldehyde in formic acid, a measuring container suitable for measuring a determined amount of the distillate fuel, a second vessel suitable for mixing the determined amount of solvent with the determined

amount of distillate fuel, and a third vessel suitable for optical analysis of the solvent phase.

33. An apparatus according to claim 32 wherein two or more of the first to third vessels are replaced by a single vessel.

34. An apparatus according to claim 33, wherein the second vessel suitable for mixing the determined amount of solvent with the determined amount of distillate fuel is also suitable for the subsequent optical analysis of the solvent phase.

35. A calibration fluid comprising a known concentration of active N-H containing heterocyclic aromatic compounds in which the nitrogen atom of the N-H group is part of the aromatic system and/or a known concentration of active metal compounds, and a hydrocarbon phase.

36. The calibration fluid according to claim 35 wherein the hydrocarbon phase is a saturated aliphatic hydrocarbon of 8 to 15 carbons atoms

37. The calibration fluid according to claim 36 wherein the hydrocarbon phase is n-dodecane.

38. The calibration fluid according to any one of claims 35 to 37 wherein the N-H containing heterocyclic aromatic compounds comprise one or more of pyrrole, indole, pyrazole, carbazole, substituted pyrroles, indoles, pyrazoles and carbazoles.

39. The calibration fluid according to claim 38 wherein the N-H containing heterocyclic aromatic compounds comprise one or more of pyrrole, indole, substituted pyrroles and substituted indoles.

40. The calibration fluid according to any one of claims 35 to 39 wherein the metal compounds comprise compounds of transition metals.

41. The calibration fluid according to claim 40, wherein the metal compounds comprise copper and/or iron compounds.

42. The calibration fluid according to any one of claims 35 to 41 having an active N-H containing heterocyclic aromatic compound content of from 0 to 250mg/l.

43. The calibration fluid according to any one of claims 35 to 42 having an active metal compounds content of from 0 to 100ppb.

44. A method of calibration of a thermal oxidative stability apparatus using one or more calibration fluids as defined in any one of claims 35 to 43, which method comprises using the one or more calibration fluids to produce one or more deposits in

the thermal oxidative stability apparatus.

45. The method of claim 44 wherein the thermal oxidative stability apparatus is a JFTOT apparatus.

46. Use of one or more calibration fluids as defined in any one of claims 35 to 43 as a reference fuel in the test method according to claim 21.